

CLAIMS

1. A method for controlling manifold absolute pressure in a hybrid electric vehicle comprising an internal combustion engine in parallel with an electric motor/generator, the method comprising the steps of:
 - monitoring the torque demand on the hybrid electric vehicle;
 - 5 monitoring the manifold absolute pressure of the internal combustion engine;
 - supplying torque from the internal combustion engine to meet the torque demand; and
 - supplying torque from the motor/generator to load-level the
 - 10 torque supplied from the internal combustion engine and to maintain the manifold absolute pressure of the internal combustion engine within an acceptable range.
2. The method of claim 1 further comprising the step of measuring the operating temperature of the internal combustion engine.
3. The method of claim 2 wherein the step of supplying torque from the motor/generator comprises the step of maintaining the manifold absolute pressure between a preselected maximum pressure value and a preselected minimum pressure value and the rate of change of manifold
- 5 absolute pressure less than a preselected rate of change if the operating temperature is below a predetermined temperature value.
4. The method of claim 2 wherein the step of supplying torque from the motor/generator comprises the step of maintaining the rate of change of manifold absolute pressure less than a preselected rate of change if the operating temperature is above a predetermined temperature value.
5. The method of claim 1 wherein the step of supplying torque from the motor/generator comprises the step of supplying a positive torque to supplement the torque supplied by the internal combustion engine.

6. The method of claim 1 wherein the step of supplying torque from the motor/generator comprises the step of supplying a negative torque in opposition to the torque supplied by the internal combustion engine to limit the rate of change of the manifold absolute pressure.

7. The method of claim 6 wherein the step of supplying torque from the internal combustion engine comprises the step of supplying torque from the internal combustion engine at a level greater than needed to meet the torque demand on the hybrid electric vehicle.

8. A system for controlling manifold absolute pressure in an internal combustion engine of a hybrid electric vehicle comprising:

a combustion propulsion system;

an electric propulsion/generator configured to operate in parallel

5 with the combustion propulsion system; and

an engine control unit coupled to the combustion propulsion system and to the electric propulsion/generator and configured to control the torque supplied by the combustion propulsion system and by the electric propulsion/generator to meet a total vehicle torque demand and to
10 maintain the manifold absolute pressure and the rate of change of the manifold absolute pressure measured in the intake manifold of the combustion propulsion system within acceptable emission control limits.

9. The system of claim 8 wherein the combustion propulsion system comprises an internal combustion engine.

10. The system of claim 9 wherein the electric propulsion/generator comprises an electric motor/generator.

11. The system of claim 10 further comprising a plurality of sensors coupled to the engine control unit and configured to send control signals to the engine control unit in response to engine and environmental conditions.

12. The system of claim 11 wherein the engine control unit comprises an engine control unit configured to control the torque supplied by the internal combustion engine in response to the signals from the plurality of sensors.

13. A method for controlling the manifold absolute pressure in a hybrid electric vehicle comprising an internal combustion engine in parallel with an electric motor/generator, the method comprising the steps of:

- 5 monitoring the temperature of the internal combustion engine;
 monitoring the torque demand of the hybrid electric vehicle;
 determining an environmentally acceptable range of manifold
absolute pressure and of rate of change of manifold absolute pressure as
measured in the intake manifold of the internal combustion engine in
10 response to the monitored temperature;
 determining the maximum torque that can be supplied by the
internal combustion engine without exceeding the environmentally
acceptable range of manifold absolute pressure and the rate of change of
manifold absolute pressure;
- 15 determining the maximum torque that can be supplied by the
electric motor/generator;
 determining whether the maximum torque that can be supplied
by the electric motor/generator is greater than or equal to the difference
between the torque demand and the maximum torque that can be supplied
20 by the internal combustion engine without exceeding the environmentally
acceptable range of manifold absolute pressure and the rate of change of
manifold absolute pressure; and
 supplementing torque supplied by the internal combustion
engine with torque supplied by the electric motor/generator to supply the
25 vehicle torque demand.

14. The method of claim 13 wherein the step of supplementing torque supplied by the internal combustion engine with torque supplied by the electric motor/generator comprises the step of supplying a positive torque from the electric motor/generator.

15. The method of claim 14 wherein the step of supplementing torque supplied by the internal combustion engine with torque supplied by the electric motor/generator comprises the step of supplying a positive torque from the electric motor/generator to avoid exceeding a maximum
5 allowable manifold absolute pressure or a maximum allowable rate of increase of manifold absolute pressure.

16. The method of claim 13 wherein the step of supplementing torque supplied by the internal combustion engine with torque supplied by the electric motor/generator comprises the step of supplying a negative torque from the electric motor/generator in opposition to the torque
5 supplied by the internal combustion engine to maintain manifold absolute pressure or rate of decrease of manifold absolute pressure above minimum allowable values.

17. The method of claim 13 wherein the step of determining an environmentally acceptable range comprises the step of determining a maximum rate of change of manifold absolute pressure and a maximum manifold absolute pressure and a minimum manifold absolute pressure as a
5 function of engine temperature between which fuel injected into a cylinder of the internal combustion engine will be combusted in an environmentally acceptable manner.

18. The method of claim 13 wherein the step of supplementing comprises the step of supplementing torque supplied by the internal combustion engine with torque supplied by the electric motor/generator to supply the vehicle torque demand without exceeding the environmentally
5 acceptable range of manifold absolute pressure and the rate of change of

manifold absolute pressure as measured in the intake manifold of the internal combustion engine.

19. The method of claim 13 wherein the step of supplementing comprises the steps of:

supplementing the torque supplied by the internal combustion engine with the maximum torque available from the electric

5 motor/generator in response to determining that the maximum torque that can be supplied by the electric motor/generator is less than the difference between the torque demand and the maximum torque; and

supplying torque from the internal combustion engine in excess of the maximum torque that can be supplied by the internal combustion
10 engine without exceeding the environmentally acceptable range of manifold absolute pressure and the rate of change of manifold absolute pressure to meet the torque demand.